

**MICHIGAN DEPARTMENT OF TRANSPORTATION  
LOCAL AGENCY PROGRAMS GUIDELINES  
FOR  
GEOMETRICS**

INCLUDING GUIDELINES FOR

New Construction/Reconstruction (4R)  
Resurfacing Restoration and Rehabilitation (3R)  
Preventive Maintenance (PM)  
and  
Design Exceptions

Approved



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- LOCAL AGENCY PROJECTS -

## **GENERAL**

## GENERAL

This manual provides information and guidelines to base the design of federal and state funded local agency road and bridge projects administered through Local Agency Programs of the Michigan Department of Transportation (MDOT). Depending upon the type of project work, these guidelines allow some latitude from the road and bridge geometrics required by the American Association of State Highway and Transportation Officials (AASHTO).

A project may be designed based upon one of two different guidelines: 1) The AASHTO current edition of *A Policy on Geometric Design of Highways and Streets*, or applicable MDOT guidelines for new construction/reconstruction, or 2) this document, *Geometric Design Guidelines for Federal/State Funded Local Agency Projects*. The latter includes guidelines for New Construction/Reconstruction (4R); Resurfacing, Restoration and Rehabilitation (3R); Preventive Maintenance; and Design Exceptions.

The guidance supplied by AASHTO's *A Policy on Geometric Design of Highways and Streets* is based on established practices supplemented by recent and continuing research. The intent of this publication is to provide a reference manual for assisting in the design of roads and bridges. As stated in the foreword to AASHTO's *A Policy on Geometric Design of Highways and Streets*:

“The intent of this policy is to provide guidance to the designer by referencing a recommended range of values for critical dimensions. Sufficient flexibility is permitted to encourage independent designs tailored to particular situations. Minimum values are either given or implied by the lower value in a given range of values. The larger values within the ranges will normally be used where the social, economic, and environmental (S.E.E.) impacts are not critical.”

Also, the foreword of the policy contains guidance for the design of 3R projects, specifically referring to TRB Special Report 214, *Designing Safer Roads: Practices for Resurfacing, Restoration, and Rehabilitation*, 1987. This is the basis of the 3R guidelines in this document.

**Design of projects on roads, streets, and bridges under local jurisdiction which are listed on the National Highway System (NHS), shall be in accordance with applicable AASHTO guidelines and MDOT Non-Freeway NHS 3R guidelines.**

The following is a chronology of events that allowed the development and implementation of this manual:

Until 1976, federal highway funds could only be used for the construction of new highways or complete reconstruction of existing systems. The 1976 Federal-Aid Highway Act broadened the term "construction" to include "resurfacing, restoration, and rehabilitation (3R)." The intent of this legislation was to permit the use of federal funds to extend the service life of the existing highway system without the excessive costs associated with major reconstruction and, at the same time, to give adequate consideration to safety. At that time, each state was given the authority by the Federal Highway Administration (FHWA) to publish and issue a policy and guide for the design of 3R projects. On August 11, 1978, MDOT distributed FHWA approved 3R guideline to be used for local agency roads on what was then termed the Federal Aid Secondary System (now generally referred to as major collectors or above). These policies and

guidelines were prepared and approved on the basis that extensive consideration is given to safety concerns.

In response to a provision in the Surface Transportation Assistance Act of 1982, the Secretary of Transportation, acting through the FHWA, requested the National Academy of Sciences to study the safety cost-effectiveness of highway geometric design standards and recommend standards for 3R projects on existing federal-aid highways, other than freeways. After extensive study by an expert staff involving several states, including Michigan, the academy published *Special Report 214, Designing Safer Roads*. This report was added, as a guide and reference, to the list of publications for application on federal-aid projects in Part 625 of Title 23, Code of Federal Regulations, in May of 1988.

With the issuance of Report 214, MDOT opted to edit and revise the 1978 guidelines for local agency 3R projects. The department, in cooperation with FHWA and three county highway Engineers, formed a committee to review and issue revised guidelines applicable to 3R projects on what was then the Federal Aid Secondary System. These guidelines were issued in February, 1990.

The Intermodal Surface Transportation Act of 1991 (ISTEA) mandates that all non-NHS projects be constructed in accordance with standards established by the state. In 1993, the State Transportation Commission approved using the 3R guidelines for non-NHS routes. These guidelines required using AASHTO's *A Policy on Geometric Design of Highways and Streets* for new and major reconstruction projects which do not meet the criteria for 3R work.

In late 1996, a task force was formed to review the existing Michigan Guidelines for Local Agency Projects. The mission of the task force is to ensure that Michigan guidelines are consistent with safe, cost-effective design of federal and state funded local agency road and bridge projects, while allowing local agencies maximum flexibility in extending the service life of their existing roadway system with available funding.

It must be understood that these guidelines provide minimum criteria. Wherever it is cost effective, values greater than these must be given serious consideration. The 3R program is to provide a design life of seven (7) to twenty (20) years. The preventive maintenance program is to provide a design life of five (5) to seven (7) years, until a more permanent improvement can be constructed.

The passage of ISTEA allowed federal aid to be used in certain maintenance type work. This Act is the basis for preventive maintenance type projects on local agency roads.

## **NEW CONSTRUCTION / RECONSTRUCTION (4R)**

## NEW CONSTRUCTION / RECONSTRUCTION (4R)

The design of any federal or state funded new construction or reconstruction project on a road or bridge under local jurisdiction shall, at a minimum, be designed using AASHTO guidelines.

Projects that are mainly comprised of the following types of work are considered new construction or reconstruction:

1. Complete removal and replacement of pavement.
2. Major alignment improvements.
3. Adding lanes for through traffic.
4. New roadways, and/or bridges.
5. Complete bridge deck or superstructure replacement.
6. Reconstruction of the roadway pavement, including more than fifty (50) percent of the subbase or subgrade, exclusive of such work as rubblizing and crushing and shaping.
7. On aggregate surface roadways, reconstruction is defined as involving more than fifty (50) percent of the subbase.

The above list is not all inclusive, but is intended to give typical examples of new construction or reconstruction work.

Refer to Michigan Design Manual Road Design Section 3.08.01.B for current definition of 4R projects. If any discrepancies exist between these guides and Section 3.08.01.B then Section 3.08.01.B shall prevail except for items 6 and 7 listed above. The following type of work found in section 3.08.01.B is exempt from these 4R guidelines, “Intermittent grade lifts that leave the existing pavement in service for less than 50% of the total project length.”

### Bridge Widths:

- For new construction or reconstruction, bridges should be designed to the minimum clear roadway width recommended by AASHTO in *A Policy on Geometric Design of Highways and Streets*. Bridge widths in excess of minimum AASHTO guidelines must be justified.
- Bridges designed to a width less than the minimum recommended by AASHTO will require a design exception. However, in no case may the approach roadway width used to determine the clear bridge width be less than the corresponding lane/shoulder widths in the Local Agency Projects 3R guidelines.
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- The “traveled way” in the AASHTO bridge width tables refers to the minimum width of traveled way (i.e., total lane width) for new or reconstructed roadways, as shown in the appropriate AASHTO table. Approach roadway width is the width of traveled way plus graded shoulders, also as shown in AASHTO.

New construction or reconstruction for road or bridge projects on the NHS must be designed, at a minimum, to applicable AASHTO guidelines.

The design speed selected for new construction or reconstruction projects shall be in accordance with the following criteria:

- The recommended design speed is 5 mph over the posted or regulatory speed.
- The minimum design speed without a design exception is the posted or regulatory speed, or 55 mph if the road is not posted in rural areas or 25 mph if the road is not posted in urban areas.



**NON-NHS**

**RESURFACING, RESTORATION AND  
REHABILITATION  
(3R)**

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## APPLICATION OF THE 3R GUIDELINES

These guidelines for Resurfacing, Restoration, and Rehabilitation (3R) are applicable to federal or state funded projects on roads and bridges under local agency jurisdiction which are not on the National Highway System (NHS) in Michigan. For features not addressed in these 3R guidelines, the requirements of AASHTO's current guide entitled, *A Policy on Geometric Design of Highways and Streets*, or applicable Michigan Department of Transportation guidelines, will govern.

The design policies and criteria described in this section are intended for projects that are to restore resurface and/or rehabilitate existing facilities within the general constraints of existing alignment and right-of-way. Examples of this type of work include, but are not limited to, the following:

1. Resurfacing, milling or profiling.
2. Lane and/or shoulder widening (no increase in number of through lanes).
3. Roadway base correction.
4. Minor alignment improvements.
5. Bridge deck overlay and/or minor widening (no increase in the number of through lanes).
6. Roadside safety improvements.
7. Signing, pavement marking and traffic signals.
8. Intersection and railroad crossing upgrades.
9. Bridge painting, joint replacements and, pin and hanger replacements.
10. Pavement joint repair.
11. Crush and shape and resurfacing.
12. Rubblize and resurface.
13. Passing relief lanes.
14. Reconstruction of the roadway pavement, including less than fifty (50) percent of the subbase or subgrade

Refer to Michigan Design Manual Road Design Section 3.08.01.A for current definition of 3R projects. If any discrepancies exist between these guides and Section 3.08.01.A then Section 3.08.01.A shall prevail except for item 14 listed above. The following type of work found in section 3.08.01.A is exempt from these 3R guidelines, "Intermittent grade lifts that leave the existing pavement in service for more than 50% of the total project length."

## **Controlling Elements Subject to Formal Design Exception**

1. Design Speed
2. Shoulder Width
3. Lane Width
4. Bridge Width
5. Structural Capacity
6. Horizontal Alignment
7. Vertical Alignment
8. Stopping Sight Distance
9. Grade
10. Cross Slope
11. Superelevation
12. Vertical Clearance
13. Horizontal Clearance (not including clear zone)

GEOMETRIC ELEMENTS	3R MINIMUM GUIDELINES - NON-NHS		
Design Speed <i>(See page C-4)</i>	Posted Speed Minimum		
Shoulder Width (ft)	ADT	Shoulder Width (ft)	
	≤ 750	2'-0"	
	751 - 2000	3'-0"	
	> 2000	6'-0"	
Lane Width (ft)	ADT	Lane Width (ft)	
	≤ 750	10'-0" (Lane width may be 9' where design speed ≤ 35 mph and ADT ≤ 250)	
	> 750	11'-0" (Lane width may be 10'-0" where design speed is ≤ 35 mph and ADT 750-1500)	
		12'-0" lanes are desirable on designated truck routes or where truck traffic ≥ 10%	
Bridges to Remain <i>(See page C-4)</i>  Bridge Width & Structural Capacity	ADT	Loading	Usable Width
	0 - 750	H 15	Width of approach lanes
	751 - 1500	HS 15	Width of approach lanes
	1501 - 2000	HS 15	Width of approach lanes plus 1' each side
	2001 - 4000	HS 15	Width of approach lanes plus 2' each side
	> 4000	HS 15	Width of approach lanes plus 3' each side
Horizontal / Vertical Alignment & Stopping Sight Distance <i>(See page C-5)</i>	Horizontal	15 mph less than posted speed may be retained without crash concentration.	
	Vertical	20 mph less than posted speed may be retained without crash concentration.	
Grade	Review crash data. Existing grade may be retained without crash concentration.		
Cross Slopes	1.5% Minimum		
Superelevation	Superelevation Tables from AASHTO "A Policy on Geometric Design of Highways and Streets," current edition. (Maximum superelevation is 6%)		
Vertical Clearance	Maintain 14'-0" minimum.		

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## **CRASH ANALYSIS**

A safety review (3 year period) shall be performed on each 3R project before starting design work. This review should include an analysis of available crash data to determine where safety enhancements are warranted.

The 3R project should incorporate features that alleviate any excessive crash patterns identified during the review. This should be considered regardless of other minimum requirements shown elsewhere in this guideline.

## **DESIGN TRAFFIC VOLUME (ADT)**

According to Special Report 214 (recommendation 14, page 204), “The design traffic volume for a given highway feature should match the average traffic anticipated over the expected performance period of that feature.” However, for 3R projects the ADT may range from the present to the anticipated design life.

## **DESIGN SPEED**

There are two methods that can be used to select the design speed for 3R projects. These may be used alone or in combination.

- Select an overall design speed greater than or equal to the posted regulatory or prima fascia speed on the section being improved.
- Determine the 85th percentile speed for the feature being designed, such as horizontal curves or vertical curves. (Documented speed study is required to apply this method)

## **BRIDGES TO REMAIN**

If lane widening is planned as part of the 3R project, the usable bridge width should be compared to the approach width after widening.

- These values do not apply to bridges greater than 100 feet in length. These structures should be evaluated individually according to clear width provided, traffic volume, remaining life of the structure, pedestrian volume, snow storage, design speed, crash record, and other pertinent factors.

The designer should evaluate retention of an existing bridge if the bridge is less than 100 feet long and the usable width or structural loading of the bridge is less than shown in the table on page C-3. When evaluating the replacement or widening, consider the following:

1. Cost of replacing the existing bridge with a wider bridge designed to AASHTO guidelines for new bridges.
2. Cost of widening the existing bridge (if practical).
3. Review of available crash data.
4. Structural condition of the existing bridge.

If the guidelines for bridge width and structural capacity are not met, a design exception is required.

## **BRIDGE RAILINGS**

Evaluation of all existing bridge railings to be left in service that have not been successfully crash-tested should be made. Retro-fitting the existing bridge railing to provide additional strength and safety characteristics in lieu of replacement of the entire rail system with a crash-tested rail, may be cost effective and feasible.

Replaced railings must meet the NCHRP 350 crash test criteria.

## **HORIZONTAL/VERTICAL ALIGNMENT AND STOPPING SIGHT DISTANCE**

### **Horizontal Curves**

Without crash concentrations that warrant revision, existing horizontal curves with a design speed 0-15 mph less than the posted speed, may be retained without further documentation. However, the operation and safety should be improved to the extent feasible through such elements as superelevation modifications, removing crown, and removal of sight obstructions to improve stopping sight distance. When the horizontal alignment does not meet the posted speed, applicable traffic control devices should be installed according to the Michigan Manual of Uniform Traffic Control Devices.

A decision not to reconstruct an existing horizontal curve where:

- the curve design speed is more than 15 mph below the posted speed shall be supported with a design exception.

### **Vertical Curves**

***CREST*** - Without crash concentration and/or other geometric features such as:

- intersections
- lane drops
- horizontal curves warranting consideration

Existing vertical curves with a design speed from 0-20 mph less than the posted speed do not require a design exception. However, designers should examine the nature of potential hazards in relation to sight distance and provide warning signs when appropriate.

***SAG*** - In general, all sag vertical curves may be retained unless a safety review indicates a problem with crashes.



### **3R SAFETY CONSIDERATIONS**

The following serves as guidance for the design of roadside features. The designer should consider site specific conditions to determine if it would be cost effective to provide improvements to side slopes and/or clear zones.

#### **SIDE SLOPES**

An effort should be made to flatten the side slopes as much as cost considerations and conditions permit. Review crash history for improvement needs. Consideration should be given to the following:

- Where run-off road crashes are likely to occur (i.e., outside of sharp horizontal curves), side slopes steeper than 1:3 within existing right-of-way should be flattened as much as conditions permit.
- Retain the current rate of side slopes when widening lanes and/or shoulders, unless steeper slopes are warranted by special circumstances. This often requires new ditches, however, the fore-slopes should not be steepened beyond the existing fore-slope rate (existing rates flatter than 1:4, may be steepened to 1:4).

#### **CLEAR ZONE**

An effort should be made to provide a uniform clear zone (i.e., a uniform distance from the edge of pavement to the tree line, utility poles, etc.) for the project length. Consideration should be given to the following:

- Removing, relocating, and/or shielding isolated roadside obstacles on the fore-slope or roadside ditches, particularly in target areas.
- Removing, relocating and/or shielding roadside obstacles with recorded crash concentrations.
- If run-off road crashes are not concentrated in any location, but there is a significant number distributed throughout the project, consider widening the average clear zone for the length of the project.

#### **TREE REMOVAL**

Consideration should be given to removing all trees, shrubs and other obstacles within the existing right-of-way in the following circumstances:

- From the fore-slope of roadside ditches.
- On the inside of curves, as needed, to meet passing sight distance requirements.
- At intersections as necessary for sight distance requirements.
- Where there is evidence of vehicle-tree crashes, either from actual crash reports or scarring of trees.
- From the target area on the outside of sharp horizontal curves.

#### **GUARDRAIL**

An analysis (including an onsite inspection of the height, length and overall condition) should be made of all existing guardrail installations to determine if continued existence or removal is appropriate. Refer to MDOT Road Design Manual, Section 3.09.03B, “Evaluation of Guardrail and Bridge Rail,” for further guidance on guardrail upgrading.

- An existing guardrail installation should be removed when:
  1. It does not meet the guidelines in the current *AASHTO Roadside Design Guide*.
  2. The cost of removing the obstacle is less than the cost of the guardrail upgrading and maintenance.
- Existing guardrail that is warranted should be upgraded to current standards (MDOT Standard Plans or Special Details and Chapter 7 “Appurtenances” of the MDOT Road Design Manual) when the design ADT is greater than 750 and:
  1. It does not conform with the current MDOT standards. (It may be retained if it meets the current MDOT standards and has a height deficiency of not more than 1 inch).
  2. It conforms with the current MDOT standards, but is seriously damaged or deteriorated.
- The following guardrail improvements should be made on existing warranted guardrail when the ADT is less than 750, horizontal curvature is 3 degrees or less, and truck traffic is 25 percent or less:
  1. Replaced where it is seriously damaged or deteriorated.
  2. Upgraded with approved terminals.
  3. Corrected for height when deficient by more than 3 inches, except in no case shall the existing guardrail be less than 2 feet in height.
- For all projects, consideration should be given to the following:
  1. Blunt ends and turned down endings should be upgraded to meet the current MDOT standards.
  2. Unconnected guardrail to bridge rail transitions should be upgraded to meet the current MDOT standards.

## **INTERSECTION DESIGN**

Designers should evaluate existing intersections when design traffic volumes on either roadway exceed 1,500 vehicles per day or there is evidence of crashes related to existing conditions. Such intersections should be reviewed during design and safety improvements and should be included in the project where practical and feasible. All available crash data should be utilized in the field review of the intersection.

Safety measures, as discussed in the Supplemental Safety Measures herein, can be utilized to mitigate safety concerns at intersections. Warning panels should be installed where appropriate.

## **TRAFFIC CONTROL DEVICES**

Signs, pavement markings, and traffic signal controls shall be installed in accordance with the current *Michigan Manual of Uniform Traffic Control Devices*.

## **SUPPLEMENTAL SAFETY MEASURES**

The design of highways provides a range of supplemental measures that can be utilized alone or in combination with others to mitigate deficiencies in controlling elements to provide for safer roadways. Where reconstruction of a roadway feature, such as a horizontal curve, vertical curve, intersection or bridge, is not feasible or prudent because of economic, social or environmental concerns, alternative safety measures should be considered. Some of these are:

Geometric ConcernSupplemental Safety Measure

Narrow lanes and shoulders

Pavement edge lines  
Paved shoulders  
Permanent pavement markers  
Post delineators  
Warning signs

Steep side slopes; roadside obstacles

Warning signs  
Slope flattening  
Round ditches  
Obstacle removal  
Breakaway hardware  
Post delineators

Narrow bridge

Traffic control devices  
Approach guardrail  
Pavement markings  
Warning signs

Poor sight distance at hill crest

Traffic control devices  
Shoulder widening  
Driveway relocation  
Warning signs

Sharp horizontal curve

Traffic control devices  
Shoulder widening  
Appropriate superelevation  
Advisory signs  
Slope flattening  
Pavement anti-skid treatment  
Obstacle removal  
Post delineators  
Permanent pavement markers

Problem intersections

Traffic control devices  
Traffic signalization  
Fixed lighting  
Pavement anti-skid treatment  
Speed controls  
Advisory signs  
Rumble strips

## **PREVENTIVE MAINTENANCE (PM)**

## **PREVENTIVE MAINTENANCE**

Preventive maintenance projects are defined by FHWA as cost-effective projects designed to preserve the existing pavement and base, and give extended life to a roadway without undertaking reconstruction or major rehabilitation.

Preventive maintenance projects:

- do not increase lane widths
- extend pavement life 5-7 years
- do not exceed an application of more than 220 pounds per square yard of bituminous material
- have base courses in good condition

A crash analysis is required for treatments that add thickness, such as bituminous overlays. The review will be to determine the merits of the project and that highway safety has been or will be addressed, if feasible. Where the crash analysis indicates existing problem areas directly related to the pavement surface, then the project shall be modified in accordance with 3R, AASHTO, or applicable MDOT guidelines as appropriate.

At a minimum, existing conditions along the route shall include the following:

- All guardrail must be in good condition and maintained to the original installed specifications and within +/- 3 inches of required height.
- Guardrail connections at bridges that are properly secured. (Turned down guardrail endings and blunt guardrail endings must be replaced with suitable endings.)

The design exception process shall not be applied to preventive maintenance projects.

It is important to note that other maintenance operations, such as crack sealing, filling of potholes, replacement of small sections of curb and gutter, drainage facility clean out, etc., are considered reactive or routine maintenance and are not eligible for federal or state aid.

## **DESIGN EXCEPTIONS**

## DESIGN EXCEPTIONS

Exceptions to particular design elements of AASHTO's, *A Policy on Geometric Design of Highways and Streets*, and Michigan's local agency 3R guidelines, may be warranted on projects at individual locations. These design exceptions shall be submitted to MDOT Local Agency Programs by the project owner. A design exception must show the need for the exception and must demonstrate that it would not create or maintain a potential or existing crash situation.

The need for a design exception should be discussed with Local Agency Programs during the early stages of the project's development. The design exception request form should be completed and submitted to Local Agency Programs along with the project program application. **Current forms can be obtained by contacting the Local Agency Programs Unit at MDOT or through the MDOT website.**

The following information must be included in a design exception request:

1. Feature and location not meeting the minimum guideline.
2. Minimum value that will be obtained.
3. Estimated cost of meeting the guideline.
4. Environmental or physical constraints that prevent the design from meeting the guideline.
5. Past traffic crash analysis at the site specific location that might be related to this design element. (If such crashes have occurred, further analysis will be required to show why upgrading is not cost effective.)
6. Discussion of whether some compromise design value could be used that would at least enhance the existing condition (include estimated cost of compromise solution).

If any of the 13 controlling design elements listed on page C-2 are not satisfied for the applicable standards, then a design exception must be submitted.

The design exception does not apply to preventive maintenance projects.